245/31

LDAA B6
STAA B7
ADDA BB
SUBA B0
WAI 3E
JMP 3E
BEQ 27

NAME: Kyle Ness

University of Saskatch
Department of Electrical Engineering
EE 331 – Microprocessor Hardware and Software
Mid-term Examination

Instructor: Seok-Bum Ko — October 27, 2003
Duration: 2 hours

- ***No materials are allowed***.

X A particular microcomputer can store an 8-bit number in each memory location. If the memory addresses range from 0000_{16} to $FFFF_{16}$, how many memory locations are there? (1)

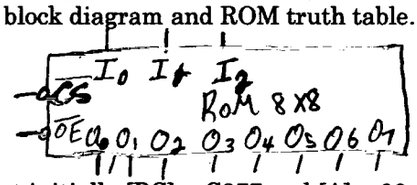
64K ✓

X. t_S (setup time) ✓ is the time interval immediately preceding the active transition of the CLK signal, during which the synchronous input has to be maintained at the proper level. (1)

X. Design a combinational circuit using a ROM. The circuit accepts a 3-bit number and generates an output binary number equal to the square of the input number. Provide the simple block diagram and ROM truth table. (2)

Assume
O_0 = MSB
O_7 = LSB
I_0 MSB
I_2 LSB

−2



I_0	I_1	I_2	O_0	O_1	O_2	O_3	O_4	O_5	O_6	O_7
0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	1
0	1	0	0	0	0	0	1	0	0	0
0	1	1	0	0	0	0	1	0	0	1
1	0	0	0	0	0	1	0	0	0	0
1	0	1	0	0	0	1	0	0	0	1
1	1	0	0	0	1	0	0	1	0	0
1	1	1	0	0	1	0	0	1	0	1

+

X. Assume that initially [PC] = C877 and [A] = 09. Also assume that the content of memory location C457 is 03.

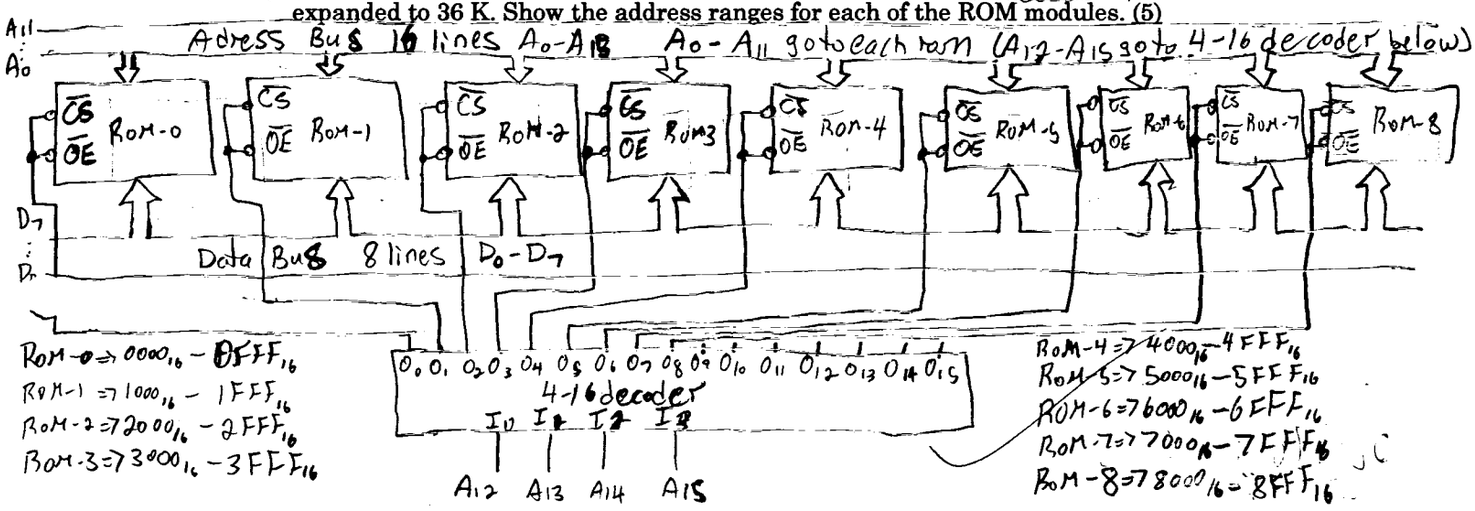
(1) At the completion of this instruction, [pc] = C87A ✓, [A] = 0C ✓, and [C457] = 03 (3) ✓

(2) Add an instruction to follow the instruction of Problem 4 so that the MPU stores the result in address C457. STAA $C457 B7C457 (1)
[PC] = C87D ✓, [A] = 0C ✓, and [C457] = 0C (3) ✓

Memory address	*Memory word*
C877	BB
C878	C4
C879	57

C87A B7
C87B C4
C87C 57

X Assume that we have a ROM of 4K × 8 size. Show how the ROM capacity can be expanded to 36 K. Show the address ranges for each of the ROM modules. (5)

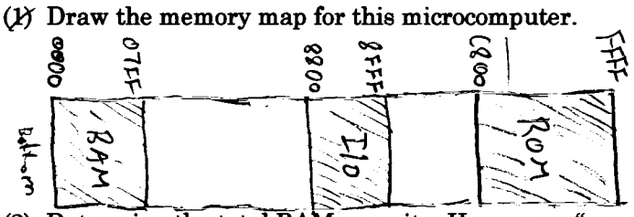


ROM-0 ⇒ 0000_{16} − $0FFF_{16}$
ROM-1 ⇒ 1000_{16} − $1FFF_{16}$
ROM-2 ⇒ 2000_{16} − $2FFF_{16}$
ROM-3 ⇒ 3000_{16} − $3FFF_{16}$

ROM-4 ⇒ 4000_{16} − $4FFF_{16}$
ROM-5 ⇒ 5000_{16} − $5FFF_{16}$
ROM-6 ⇒ 6000_{16} − $6FFF_{16}$
ROM-7 ⇒ 7000_{16} − $7FFF_{16}$
ROM-8 ⇒ 8000_{16} − $8FFF_{16}$

A certain microcomputer allocates addresses 0000 to 7FFF to RAM, 8800 to 8FFF to I/O, and C800 to FFFF to ROM. (4)

(1) Draw the memory map for this microcomputer.



(2) Determine the total RAM capacity. How many "pages"? How many "4K pages"? 8 pages & 1/2 of a 4K page

(3) Determine the total ROM capacity. How many "pages"? How many "4K pages"? 56 pages & 3 1/2 4K pages.

(4) How many different I/O devices can this microcomputer accommodate? 2K or 2048 devices.

Consider the following program and assume that the stack pointer register is initially loaded with 6200_{16}. Show the contents of the stack after each instruction. What are the contents of the stack pointer register at the end of the execution? $61FD_{16}$ (3).
Add the instructions so that the MPU pull all the contents off the stack.
PULB PULX PULA (not in order since stack is LIFO) (1)
What are the contents of the stack pointer register at the end of the execution?
6200_{16} (3)

PSHA — $61FF_{16}$
PSHX — $61FE_{16}$
PSHB — $61FD_{16}$

The function of this program is to add two 8-bit numbers (X and Y) that are stored in memory locations C100 and C101, respectively. The sum is then stored in address C102. Provide the followings for this program. (4)
- Memory address (hex), memory word (hex), Mnemonic, and brief description.

Memory address	Memory Word	Mnemonic	brief description
CB00	B6	LDAA	loads [A] with value stored at memory location C100.(X)
CB01	C1		
CB02	00		
CB03	BB	ADDA	Adds contents of memory location C101(Y) to the contents of [A] and puts result in [A] (X+Y)
CB04	C1		
CB05	01		
CB06	B7	STAA	stores the contents of [A] (X+Y) in memory location C102.(X+Y)
CB07	C1		
CB08	02		

The END

C100 = X
C101 = Y
C102 = X+Y